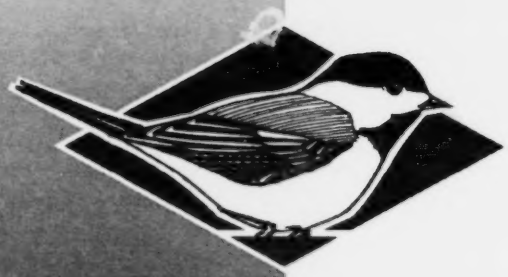

Fish & Wildlife Division

SPECIES AT RISK

Beneficial Management Practices for Ord's Kangaroo Rat in Alberta

Alberta Species At Risk Report No. 125

Alberta

Beneficial Management Practices for Ord's Kangaroo Rat in Alberta

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EXECUTIVE SUMMARY

The *Recovery Plan for Ord's Kangaroo Rat in Alberta* identifies the development of beneficial management practices (BMPs) for Ord's kangaroo rat (*Dipodomys ordii*) as a recovery action contributing to the maintenance and recovery of this species in Alberta. The purpose of this document is to identify BMPs for resource managers and land users that will help mitigate effects of land use activities on this species and its habitat. These BMPs apply to a variety of land uses in Alberta including agricultural, industrial, rural, urban, commercial, access development and management, and military activities. Although developed specifically for use in Alberta, these recommendations may also be applicable to other populations of this species in Canada (i.e., Saskatchewan) or elsewhere. The recommendations were developed using current knowledge of this species' biology and habitat requirements, and based on known or anticipated effects of land use on this species, other species of kangaroo rats and other small mammals. These BMPs may require revision and update as new information on Ord's kangaroo rat or related species becomes available.

DISCLAIMER

The views and opinions expressed in this report are those of the author and do not necessarily represent the policies or positions of Alberta Sustainable Resource Development, the Alberta Fish and Wildlife Division, or the Alberta Government.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

1.0 BACKGROUND

The *Recovery Plan for Ord's Kangaroo Rat in Alberta* identifies the development of beneficial management practices (BMPs) for Ord's kangaroo rat (*Dipodomys ordii*) as a recovery action contributing to the maintenance and recovery of this species in Alberta (Alberta Ord's Kangaroo Rat Recovery Team [AOKRRT] 2005). The purpose of this document is to describe BMPs for resource managers and land users that will help mitigate effects of land use activities on this species and its habitat. These BMPs apply to a variety of land uses in Alberta including agricultural, industrial, urban, rural, commercial, access development and military activities. Although developed specifically for use in Alberta, these recommendations may also be applicable to other populations of this species in Canada (i.e., Saskatchewan) or elsewhere. The recommendations were developed using current knowledge of this species' biology and habitat requirements, and based on known or anticipated effects of land use on this species, other species of kangaroo rats and other small mammals. These BMPs may require revision and update as new information on Ord's kangaroo rat or related species becomes available.

Ord's kangaroo rat is widely distributed across the deserts and arid grasslands of western North America (Committee on the Status of Endangered Wildlife in Canada [COSEWIC] 2006). The species occurs at the northern limit of its range in sand hill areas of southeastern Alberta and southwestern Saskatchewan (Schmidly et al. 1993; Gummer 1995, 1999; Gummer and Robertson 2003a; AOKRRT 2005; COSEWIC 2006). Approximately 62% of the Canadian range of this species occurs in Saskatchewan and 38% occurs in Alberta. Kangaroo rats are listed in Alberta and Canada as 'Endangered' (COSEWIC 2006). Under Alberta's *Wildlife Act* it is illegal to collect, possess or kill kangaroo rats or to wilfully disturb or destroy their nests or dens on provincial lands. Under the *Species at Risk Act*, it is illegal to kill, harass, capture, take, possess, collect, buy, sell or trade kangaroo rats and to damage or destroy the residence of kangaroo rats on federal lands. Approximately one-third of the Alberta range of Ord's kangaroo rat and as much as two-thirds of the provincial population occur on federal land within the boundaries of Canadian Forces Base (CFB) Suffield (AOKRRT 2005). Within CFB Suffield, over half of the range of Ord's kangaroo rat is within a National Wildlife Area (NWA) designated under the *Canada Wildlife Act*. In Saskatchewan, the species is ranked as "S2" meaning that it is rare and vulnerable to extirpation because of some factor of its biology (Saskatchewan Environment 2008). In Saskatchewan, the *Critical Wildlife Habitat Protection Act* prevents the clearing and breaking of Crown lands, providing some protection for kangaroo rat habitat. In addition, the *Representative Areas Ecological Reserves Act* prevents cultivation and new industrial developments within a portion of the Great Sand Hills in Saskatchewan within the range of this species.

Kangaroo rats are believed to play a significant ("keystone") role in grassland and desert communities through their effect on plant communities (e.g., seed foraging, caching and dispersal), soil disturbances, and as prey for many other species (Brown and Heske 1990; Heske et al. 1993; Brock and Kelt 2004). As such, decline or loss of kangaroo rats from the grasslands is expected to negatively affect the structure and dynamics of native prairie ecosystems (COSEWIC 2006). Canadian populations of Ord's kangaroo rat exhibit

unique life history and physiological characteristics not observed in conspecifics from more southern populations, including larger body size, rapid sexual maturity, high reproductive rates, use of torpor, and bot fly (*Cuterebra polita*) parasitism, suggesting that Canadian populations are distinct from other kangaroo rat populations (Kenny 1989; Gummer et al. 1997; Gummer 2005). Actions that protect kangaroo rats and their habitat may also help maintain or restore populations of other sand dune-dependent species that are also at risk in Alberta.

1.1 Species Biology

Ord's kangaroo rat is a medium-sized, nocturnal rodent in the family Heteromyidae. It is the only species of kangaroo rat in Alberta (and Canada) and only one of two Heteromyid species in the province (the other species is the olive-backed pocket mouse, *Perognathus fasciatus*). Heteromyid rodents are highly adapted for survival in deserts and arid grasslands in North America (Garrison and Best 1990; Schmidly et al. 1993). Ord's kangaroo rat has orange-brown dorsal pelage, white ventral fur, large eyes, five-toed feet and an extremely long tail (Garrison and Best 1990). Kangaroo rats are so-named for their bipedal, hopping-style of locomotion that is facilitated by enlarged hind limbs, reduced fore limbs and long tail (Bartholomew and Caswell 1951; Yousef et al. 1970). They are fossorial (i.e., adapted to live below ground) and construct extensive underground burrows and tunnels in loose sandy soils. Kangaroo rats spend most of their lifetime below ground, emerging from burrows only at night to forage and search for mates (Kenagy 1973; O'Farrell 1974; Kaufman and Kaufman 1982; Gummer 1997a,b). Above-ground activity levels of kangaroo rats are affected by ambient light (Kaufman and Kaufman 1982), with individuals showing highest activity levels during the darkest of nights (e.g., during periods when moonlight and artificial light are absent). The diet of Ord's kangaroo rat consists primarily of seeds, which they collect in external, fur-lined cheek pouches and cache in their burrows, although they also eat green vegetation (e.g., stems) and insects (Best and Hoditschek 1982; Garrison and Best 1990; Gummer et al. 2005). Food composition, quality and availability likely affect their overwinter survival (COSEWIC 2006). In Alberta, kangaroo rats forage on a wide variety of plants, but annual sunflower (*Helianthus couplandii*), cactus (*Opuntia* spp.) and scurph pea (*Psoralea lanceolatea*) are common native species found in their diets (Gummer et al. 2005). Non-native weedy species such as knotweed (*Polygonum aviculare*) and Russian thistle (*Salsola kali*) are also collected, particularly in human-modified habitats (Gummer et al. 2005).

In the northern portion of the species' range, kangaroo rats are typically active above ground between April and November (snow-free periods; Gummer 1997a,b, 2005). In winter, they use torpor (hibernation) to conserve resources when foraging opportunities are constrained by snow and extreme cold. No other population (or species) of kangaroo rat has been found to use torpor in the wild (Gummer 2005). Although typical winter conditions constrain above-ground activities and favour torpor, on unseasonably warm nights during winter kangaroo rats may emerge to forage, and rarely, to mate (Gummer and Robertson 2003b).

Kangaroo rats are solitary animals and highly territorial (Bartholomew and Caswell 1951; Eisenberg 1963; Garner 1974; Daly et al. 1984). Home range size averages approximately 1,750 m^2 (Gummer and Robertson 2003b). Juveniles typically disperse from their natal territory, whereas adults are less likely to disperse (Gummer 1997a).

Canadian populations of kangaroo rats exist at the northern edge of the species' range and they have likely been subject to high selection pressure due to the extreme winter conditions experienced at those higher latitudes. That, combined with isolation of Canadian populations from southern populations for as much as 6,000 years, has apparently favoured several unique traits in Canadian populations not observed in other populations of kangaroo rat of any species; unique traits include larger body size, use of torpor and rapid sexual maturity (Gummer 1997a, 2005; AOKRRT 2005; COSEWIC 2006). These distinct characteristics make the Canadian population particularly difficult to recover from extirpation because animals of the same species from more secure, southern areas of their range (e.g., USA or Mexico) do not possess these traits and would not be expected to survive well in Canada. In addition, Canadian populations of Ord's kangaroo rat are isolated from southern populations of this species by approximately 270 km, which is well beyond the species' natural dispersal capabilities (AOKRRT 2005; COSEWIC 2006).

The kangaroo rat population in Canada experiences large fluctuations in population size due to high summer reproductive output and low overwinter survival (COSEWIC 2006). Fewer than 1,000 individuals are estimated to survive a typical winter. Natural or anthropogenic (human-created) factors that further reduce survival of kangaroo rats may exacerbate these fluctuations, potentially putting the population at even greater risk of extinction.

1.2 Habitat Requirements

Ord's kangaroo rats require open, sparsely-vegetated, sandy soils that allow for their hopping style of locomotion and excavation of extensive underground burrow systems. In Alberta, their natural habitat is generally restricted to actively-eroding sand dunes, sand flats and sandy slopes in sand hill areas (COSEWIC 2006). Sand dune habitats are naturally patchy in Alberta and are becoming increasing rare on the Canadian prairies due to stabilization by vegetation (Bender et al. 2005; Hugenholtz and Wolfe 2005; COSEWIC 2006). Although stabilization of active sand dune habitats has typically been thought to be largely influenced by climatic factors (Wolfe et al. 2001; Hugenholtz and Wolfe 2005), stabilization is believed to be exacerbated by altered grazing and fire regimes and other human land use practices (AOKRRT 2005; Bender et al. 2005; Hugenholtz and Wolfe 2005; COSEWIC 2006; Wolfe et al. 2007). Historical factors, such as fire or grazing disturbance by bison, may have been important for maintaining wind erosion on active sand dunes, and the removal or suppression of these historical sources of disturbance may be contributing to the recent stabilization trends (Forman et al. 2001; Hugenholtz and Wolfe 2005; Wolfe et al. 2007). Recent estimates of stabilization rates of sand dunes in the Middle Sand Hills show that natural sand dune habitat is disappearing at a rate of 40% per decade (Bender et al. 2005). At this rate, all

active sand dunes in the Middle Sand Hills are projected to disappear as early as 2014 (Bender et al. 2005; COSEWIC 2006). A study is currently underway to investigate the role of disturbances (fire and native ungulate grazers) for maintaining actively-eroding sand dune habitat (D. Bender, pers. comm.).

As natural sand dune habitats have declined in recent decades, the footprint of human development has increased throughout the species' range in Alberta. Kangaroo rats frequently use sandy, human-created features/habitats such as unpaved roads, trails, fireguards, exposed soils associated with oil and gas infrastructure, heavily grazed pastures or livestock trails, or margins of agricultural fields (Nero and Fyfe 1956; Smith and Hampson 1969; Gummer 1997a, 1999; Bender et al. 2005). During periods when the population is at peak numbers, more than half of the Alberta population of kangaroo rats may occupy these alternative habitats (D. Bender, pers. comm.). Superficially, these areas appear to provide the necessary sandy and open areas required by kangaroo rats, but human-created sandy habitats may be much lower in quality, and are hypothesized to act as population 'sinks' (COSEWIC 2006). These habitats are generally prone to disturbance from traffic, mowing, grading and tilling, and thus are subject to direct risk of mortality to individuals or destruction of burrows. Recent research has demonstrated that kangaroo rats living along roads, trails or other human-created linear features are likely to also suffer higher rates of predation (Bender et al. 2005; Teucher 2007), and in some years parasitism (Robertson 2007). Research has also shown that kangaroo rat body condition and probability of survival are lower along these human-created features than for kangaroo rats living in natural habitats (Teucher 2007). As such, these human-created habitats are believed to represent 'attractive sink' habitats which kangaroo rats occupy but suffer periodic, unsustainably high mortality (i.e., mortality > recruitment) and frequent local extirpation (see also *2.4 Access Development and Management*).

1.3 Key Management Issues

Based on the biology and general habitat requirements of this species, several key management issues related to land use and conservation of this species' habitat are:

i. Conservation and restoration of sand dune habitats and other sandy areas that provide habitat for the species.

ii. Prevention of habitat loss that occurs from vegetation encroachment and stabilization.

iii. Protection of natural sandy habitats must be prioritized over protection of human-created sandy habitats.

iv. BMPs should be applied in all areas where kangaroo rats are known to occur, including both natural and human-created sandy habitats.

2.0 BENEFICIAL MANAGEMENT PRACTICES

2.1 Agricultural Activities

Kangaroo rat populations in Alberta have evolved and persisted under native and domestic grazing regimes (AOKRRT 2005). Agricultural activities have the potential to affect kangaroo rats primarily through (1) livestock grazing of intact, uncultivated prairie; (2) management practices that discourage soil erosion, suppress fire and increase vegetation cover; and (3) cultivation of natural sandy habitats (COSEWIC 2006).

Kangaroo rats generally respond positively to grazing or other activities that limit or control vegetation cover (Price et al 1994a; Jones and Longland 1999; Jones et al. 2003; Waser and Ayers 2003). In experimental studies of the effects of grazing, abundance of kangaroo rats is typically higher in grazed versus ungrazed habitats (e.g., Reynolds 1950; Jones et al. 2003) and in heavily-grazed versus lightly-grazed areas (e.g., Jones and Longland 1999). Thus, a moderate amount of well-managed grazing is believed to benefit kangaroo rats by reducing vegetation structure and increasing the amount of bare ground required by kangaroo rats to facilitate their bipedal movement (Jones et al. 2003) and burrowing, which helps to prevent stabilization of sandy habitats (Reynolds 1950; D. Bender and D. Gummer, pers. comm.). In a portion of the Great Sand Hills in Saskatchewan, Nielsen and Bjork (2007) reported that occurrence of Ord's kangaroo rats increased near (within 150 m of) cattle watering holes which encompassed areas with little vegetation cover, providing that these sites had regosolic soils and were in areas classified as disturbed. There is no reason to expect kangaroo rats to select habitats near to water or riparian habitats, or areas with shallow water table; rather, this apparent relationship is evidence of the positive effect of localized grazing on habitat suitability for kangaroo rats. However, Nielsen and Bjork (2007) also found that presence of some invasive plants increased near watering holes, suggesting that the quality of forage available to kangaroo rats in these areas may be lower. There is also potential for livestock to trample individual kangaroo rats or crush burrows; however, the potential for livestock grazing to help create or maintain patches of open, sandy habitats likely outweighs its potential negative effects (COSEWIC 2006).

Grazing management practices that discourage erosion and promote vegetation cover could lead to stabilization of sandy areas and reduce the suitability of these areas for kangaroo rats (COSEWIC 2006). In CFB Suffield, the practice of stabilizing sand dunes using flax bales was discontinued in 1992 and, in 1997 and 1998, elk were reintroduced in CFB Suffield in an effort to re-establish a large, native grazer (AOKRRT 2005). A common practice associated with agriculture in arid grasslands is the ploughing of fireguards, particularly in areas that may be susceptible to wildfire. These fireguards are often colonized by kangaroo rats, although there are several reasons why human-created linear features may represent low quality habitat for kangaroo rats (see *2.4 Access Development and Management*). However, there are also several fireguards in Alberta that appear to have relatively stable numbers of kangaroo rats from year to year. This stability appears to be associated with extremely low vehicle traffic, infrequent

maintenance, and low connectivity with other linear features (i.e., these fireguards generally do not connect to multiple roads or other fireguards; D. Bender, pers. comm.).

While certain types of disturbance appear necessary to prevent vegetation from stabilizing sandy habitats, cultivation is not a compatible form of disturbance for maintaining habitat for this species. Historical conversion of sandy habitats for crop production likely played a role in loss of habitat and local populations of kangaroo rats, and enhanced fragmentation (isolation) of remaining populations (COSEWIC 2006). Conversion of remaining sand dune habitats is not likely, except very locally, given that these habitats are small and dispersed and not conducive to crop production. Kangaroo rats typically do not use cultivated fields, although some kangaroo rats colonize temporary fallow fields or the sandy margins of cultivated fields (Gummer and Robertson 2003a; COSEWIC 2006). These habitats are occupied only over the short-term and are subject to regular mechanical disturbance (e.g., cultivation). Thus, kangaroo rat populations in these sites may be subject to local population extinctions, either via direct mortality from machinery crushing animals and/or burrows, potential mortality from poisoning by pesticides or herbicides, increased emigration due to burrow disturbance, or indirectly if these areas represent lower quality habitats due to lower forage quality, increased predation or parasitism. Use of these sites may contribute to fluctuations in overall population size of this species (Gummer and Robertson 2003a), and further instability of populations.

For areas of previously cultivated lands in this region that are dominated by sandy soils and are particularly susceptible to soil erosion (e.g., sand blow-outs and drifts), encouraging conversion to permanent native cover for grazing may be beneficial. This would assist soil conservation and create habitat for grassland species, including kangaroo rats. In the long-term, livestock grazing would presumably be much more sustainable and compatible with kangaroo rats than ongoing mechanical cultivation.

2.1.1 Beneficial Management Practices for Agricultural Activities

- Maintain actively-eroding sandy habitats required by kangaroo rats, which may require a moderate level of grazing by native ungulates and livestock; graze annually – livestock should **not** be excluded as a means to protect the species or its habitat.
- In sand hill habitat, avoid other range management practices that discourage erosion or promote enhanced vegetation cover.
- Avoid cultivating sandy soils, particularly sand dunes, sand flats and steep slopes in sand hill areas.
- Avoid use of heavy machinery in sandy habitats or in areas where kangaroo rat burrows are observed.
- Avoid direct application of pesticides, herbicides or other chemicals to areas inhabited by kangaroo rats.
- Minimize vehicle traffic on fireguards, and maintain them late in the spring rather than early in the spring when kangaroo rats are more sensitive to disturbance.

2.2 Industrial Development

Industrial development, particularly oil and gas exploration and development, continues to expand within the range of Ord's kangaroo rat in southeastern Alberta. Specific examples of industrial activities that occur within the range of Ord's kangaroo rat include installation of wells, pipelines, refineries, compressor stations, exploration (e.g., seismic) surveys, and associated infrastructure (e.g., roads and access trails) and maintenance activities. Industrial activities have the potential to impact kangaroo rats through (1) habitat alteration; (2) impacts on their survival either from direct or indirect sources; and (3) effects on their behaviour (AOKRRT 2005; COSEWIC 2006). All of these effects may reduce the suitability of the habitat and likelihood of survival of kangaroo rats, and ultimately the viability of the population. The duration or permanence of industrial disturbances may affect kangaroo rats to varying degrees. For example, development activities that are brief in duration (installation of a wellsite that is visited infrequently) may have less total impact than developments which are more permanent in nature (e.g., construction of a permanent road or compressor station).

General effects on habitat – Installations and infrastructure (e.g., access routes) associated with industrial development potentially reduce habitat for this species. Sand dunes and sand flats are naturally fragmented across the landscape; however, access developments may further fragment populations by disrupting dispersal between natural sandy habitats (see *2.4 Access Development and Management*). Whenever possible, multi-pad installations and/or existing infrastructure should be used to reduce habitat loss and fragmentation. Practices associated with development and reclamation, such as use of straw crimping, drift fences and landscape fabrics may impede movements of kangaroo rats or artificially enhance vegetation cover, thereby increasing stabilization of the habitat and decreasing its suitability to kangaroo rats (D. Gummer, pers. comm.). Thus, use of these tools should be minimized, whenever possible, in habitats used by kangaroo rats.

Effects on survival, home ranges, and use of torpor – One of the few studies of effects of industrial activities on kangaroo rats investigated the effect of pipeline construction activities and mitigation efforts on Ord's kangaroo rats during the development of the North Suffield Pipeline in Alberta (Gummer and Robertson 2003b). During construction, several special mitigation measures were implemented including: (1) a predevelopment survey to establish the exact location of burrows of resident kangaroo rats; (2) marking of burrow locations to prevent accidental crushing or collapsing of burrows; (3) vehicle restrictions, so that no trucks or large vehicles were allowed where kangaroo rats were known to occur, and access by other large vehicles was restricted to a minimum; and (4) no night-time construction activities or lights were allowed. With these special mitigations in place, Gummer and Robertson observed no direct effects of construction on survival (i.e., mortality) of kangaroo rats during the one-year study. However, kangaroo rats along the pipeline route exhibited smaller home ranges than individuals in an undisturbed area, and were less likely to hibernate throughout the winter. Both of these factors could lead to reduced overwinter survival if smaller home range sizes were associated with smaller food caches, which would ultimately affect hibernation and

typically, overwinter survival. The winter following construction of the North Suffield Pipeline was unusually mild and kangaroo rats actually foraged above ground during the winter, even attempting to mate in January. Gummer and Robertson (2003b) speculated that, during more typical (i.e., colder) winter weather conditions, the observed differences in home range size and propensity for hibernation may have been more likely to translate into reduced survival for kangaroo rats. Long-term effects of pipeline construction were not investigated; however, the abundance of kangaroo rats observed at the pipeline site from 2005–2008 was greatly reduced from that during the original study (D. Bender, pers. comm.). Gummer and Robertson (2003b) indicated that because the mitigation measures used during construction were apparently successful in avoiding at least direct mortalities during construction, they should be implemented as a minimum standard for all industrial development within the range of kangaroo rats.

Effects of artificial lighting – Kangaroo rats are highly sensitive to ambient light conditions and restrict their behaviour in response to bright moonlight (Kaufman and Kaufman 1982). Light from industrial developments and installations (e.g., gas refineries and compressor stations), or construction activities at night that require bright lights, are expected to similarly influence kangaroo rat behaviour and should be minimized (Gummer and Robertson 2003b).

Effects of noise – Kangaroo rats have highly specialized ears and are particularly sensitive to low-frequency sounds (Webster 1962; Webster et al. 1968; Webster and Webster 1980; McGinn and Faddis 1997). Night-time construction when kangaroo rats are active, or operation of facilities that produce intermittent or continuous noise (e.g., compressor stations), have the potential to influence behaviour or even damage hearing of kangaroo rats. In an experimental study of the effect of off-road vehicle noise on hearing by kangaroo rats, Brattstrom and Bondello (1983) found that desert kangaroo rats (*D. deserti*) experienced temporary hearing loss in response to 500-s exposures to off-road vehicle noise (95 dBA, approximately the noise level created by a dune buggy). Although hearing loss was temporary, hearing ability did not return to pre-exposure levels for three weeks following exposure and individuals had reduced ability to detect auditory cues of predatory snakes during that period. Consequently, exposure to noise, even for brief durations, may affect survival (Brattstrom and Bondello 1983).

Effects of seismic activity – Although apparently not studied for any ground-dwelling mammal, seismic studies conducted during petroleum exploration activities may disturb kangaroo rats and other animals that spend much of their time in underground burrows. Kangaroo rats are very sensitive to seismic vibration, given their ability to detect foot-drumming patterns of conspecifics. Randall (1994) showed that kangaroo rats (*D. spectabilis*) were able to distinguish familiar neighbouring conspecifics from strangers, using minor variations in foot-drumming patterns. Although not documented, excessive seismic vibration may have the potential to collapse burrows, especially in natural habitats where burrows are typically constructed in very loose, sandy soils.

Effects on diet – Disturbance and vegetation removal activities associated with many industrial developments increase the potential for invasive, non-native plant species to

colonize and spread through native habitats. Food composition and quality likely affect overwinter survival of kangaroo rats (COSEWIC 2006) and it is hypothesized that seeds from non-native species may be lower in quality than those of native species (Gummer et al. 2005). Thus, practices to reduce the invasion of non-native species should be undertaken when working in habitats used by kangaroo rats, and should include cleaning equipment and undercarriages of vehicles prior to accessing work sites, and using certified weed-free seed mixes for revegetating disturbed areas. Application of herbicides should be avoided, whenever possible. In areas where kangaroo rats occur, guidelines for revegetation/reclamation of development sites (e.g., Native Plant Working Group 2001; Sinton 2001) may be altered slightly to increase suitability for kangaroo rats. Gummer et al. (2005) investigated the diet of Ord's kangaroo rats in Alberta to provide recommendations of potential native seeds for reclamation of disturbed sites in the Middle Sand Hills. Based on species that represented large components of the natural diet, Gummer et al. (2005) recommended that standard native seed mixes used in reclamation be augmented with species such as scurf pea (*Psoralea lanceolata*), annual sunflower (*Helianthus couplandii*), narrow-leaved puccoon (*Lithospermum incisum*), northern wheat grass (*Agropyron dasystachyum*), prickly pear (*Opuntia* sp.), western bluebur (*Lappula occidentalis*) and sand dropseed (*Sporobolus cryptandrus*), where feasible within the development area.

Predevelopment surveys and environmental assessments are typically part of the application and approval processes for industrial developments on both provincial and federal lands in Alberta, and serve to help mitigate effects on sensitive wildlife habitats or species. Inventory guidelines for identifying presence of Ord's kangaroo rats and burrows are available (Alberta Sustainable Resource Development 2005; Bender et al. 2007). Multi-species survey techniques or standard trapping methods that rely on live-trapping should not be used, since they do not reliably detect kangaroo rats and often lead to injury or death (Reynolds et al. 1999; Gummer and Robertson 2003a; Bender et al. 2007). Practices that enhance awareness of workers to sensitive species and habitats in the development areas should be encouraged. Within CFB Suffield, standard operating procedure requires a range briefing for workers on the Base. These range briefings undertaken by Suffield Industry Range Control serve to increase workers' awareness of sensitive habitats and species.

Several guidelines are available to operators for minimizing general effects of development on native prairie habitat during the construction or reclamation phases (e.g., Native Plant Working Group 2001; Sinton 2001; Alberta Energy and Utilities Board 2002; Native Prairie Guidelines Working Group 2002; Special Areas Board 2008). Land use guidelines are also available to mitigate effects of industrial development on provincial or federally listed species or other sensitive species, including kangaroo rats (e.g., Scobie and Faminow 2000; Alberta Sustainable Resource Development 2001; Saskatchewan Environment 2003, Alberta Sustainable Resource Development, in review). These guidelines specify periods when activity should be restricted or limited and specify **minimum** setback distances to buffer activities near sensitive features (e.g., nests or dens). There is variation in the recommended guidelines across jurisdictions and provinces, particularly with respect to mitigating effects of large or permanent

disturbances (Tables 1-3). Given that there is no regulation or legislation mandating their use, there is also variation in compliance with these guidelines depending on the project, regulating agency and operator undertaking the development. Updated proposed land use guidelines for Alberta lands (Table 1, Alberta Sustainable Resource Development, in review) are awaiting formal approval, but these guidelines are currently being recommended at an operational level to minimize adverse effects on this species. Updated federal guidelines are currently under review, as well.

Table 1. Updated proposed Alberta activity restriction guidelines for Ord's kangaroo rat on Alberta lands from Alberta Sustainable Resource Development (in review). Note, that these recommended minimum setback distances are similar to earlier provincial guidelines for this species (Alberta Sustainable Resource Development 2001), except that the setback distance for 'high' land use activities has been increased from 100 m to 250 m.

Wildlife key area	Restricted activity dates	Setback distances by land use activity		
		Low	Medium	High
Den and surrounding habitat	Year round	50 m	100 m	250 m

Table 2. Saskatchewan activity restriction guidelines for Ord's kangaroo rat in natural habitats from Saskatchewan Environment (2003).

Key wildlife area	Restricted activity dates	Recommended setback distance by disturbance category		
		Low	Medium	High
Den	Year round	50 m	250 m	500 m

Table 3. Recommended guidelines for petroleum industry activities with respect to Ord's kangaroo rat in Scobie and Faminow's (2000) guidelines for COSEWIC Prairie and Northern Region vertebrate species at risk.

Timing	Recommended setback by activity				
	Low	Low-Med	Med	Med-High	High
1 Apr – 15 Aug (breeding)	50 m	100 m	250 m	250 m	500 m
16 Aug – 15 Nov (pre-winter)	50 m	250 m	500 m	500 m	500 m
16 Nov – 31 Mar (winter)	50 m	100 m	250 m	250 m	500 m

The timing of development activities on the landscape may also affect kangaroo rats. Generally, activities that are conducted during winter (when the ground is frozen) likely minimize disturbance of kangaroo rat habitat. However, winter development activities should not be conducted unless predevelopment surveys were conducted just prior to arrival of snow cover, because snow reduces kangaroo rat activity and precludes

detection of burrows and tracks. If predevelopment surveys are conducted too early (i.e., mid-summer or earlier) prior to winter development activities, it is possible that unoccupied sites will become inhabited at some time between the survey and development. These new inhabitants would be highly sensitive to mortality either directly through the potential to be crushed in their burrows or indirectly through behavioural disturbance or loss of their overwinter seed caches that are critical to winter survival. Thus, it is crucial that predevelopment surveys for kangaroo rats be conducted early enough in the fall period to observe active animals or evidence of kangaroo rat activity, but late enough in the season that there is little chance of new occupation of the site by dispersing kangaroo rats. The optimal timing for surveys will vary from year to year depending on weather conditions, and therefore the precise dates are difficult to specify. For winter development activities, typically it would be appropriate to conduct predevelopment surveys between mid-September and the onset of partial snow cover (typically early November) (D. Gummer, pers. comm.) on dry, warm (nightly low temperature >5˚C), dark nights (e.g., a new moon period) that provide adequate survey conditions (see Alberta Sustainable Resource Development 2005; Bender et al. 2007).

If it is not possible to delay development activities until winter, then the same principles should apply – surveys should occur immediately prior to development to avoid the risk of kangaroo rats later colonizing the site. Surveys should be conducted under appropriate survey conditions, including dry, warm, dark nights (e.g., new moon period) (see Alberta Sustainable Resource Development; Bender et al. 2007). If there is potential for night-time traffic or construction activities during development, that work should occur during bright nights (e.g., week of the full moon) when kangaroo rats are typically less active.

2.2.1 Beneficial Management Practices for Industrial Development

- Development activities should be conducted in winter, whenever possible, providing that predevelopment surveys are conducted immediately prior to snow cover.
- Predevelopment surveys must be conducted at optimal times of the season to accurately identify presence of the species and to determine precise locations of burrows.
- Surveys should be conducted at night during a new moon period, following protocols outlined in Alberta Sustainable Resource Development (2005) and Bender et al. (2007). These surveys should be conducted by individuals familiar with kangaroo rats and experienced with survey protocols for this species.
- Conventional small mammal trapping techniques that use live-traps (i.e., box traps) are unreliable and possibly lethal to kangaroo rats, and are strongly discouraged within the range of Ord's kangaroo rat.
- Land users should follow recommended **minimum** setback guidelines to help ensure protection of individuals and their burrows.
- Whenever possible, use existing infrastructure or minimize infrastructure by using multi-pad wellsite installations at a single location rather than multiple, single wellsite installations.
- Minimize construction activities that generates noise, seismic vibration, or artificial light at night when working near kangaroo rats or their habitats.

- Minimize all night-time traffic, activities, artificial light and noise.
- Minimize vehicle access, and use foot traffic whenever possible.
- Where vehicle traffic must occur, all kangaroo rat burrows should be conspicuously marked and avoided to prevent destruction or crushing of residences.
- Ensure that any traffic stays on existing access routes and does not venture off established roads/trails, particularly if there are burrows nearby.
- Minimize vegetation disturbance.
- Implement practices which reduce likelihood of invasion by weedy, invasive species, such as cleaning equipment and vehicles prior to accessing work sites and use of certified weed-free seed mixes during reclamation.
- Avoid use of herbicide to reduce invasion by weedy, non-native species at development sites, particularly within and nearby kangaroo rat habitats.
- Re-seed using native species only, and include species that are beneficial to the diet of kangaroo rats, whenever possible.
- Minimize use of erosion control measures and over-seeding during reclamation.

2.3 Rural, Urban and Commercial Development

Habitat used by kangaroo rats in Alberta is not under imminent, wide-spread threat of development associated with urban or commercial development, primarily because of its isolation or inaccessibility (e.g., CFB Suffield lands). If such activities were to occur, similar effects to those from industrial development, including habitat alteration, survival consequences, and behavioural changes may be expected, and similar BMPs should be implemented during construction (see *2.2 Industrial Development*). If any large-scale developments that may cause major changes to regional land use (e.g., dams that create new reservoirs) are proposed, these proposals should be reviewed for potential implications for kangaroo rats and their habitat.

There is the potential for small-scale developments of rural residences or associated infrastructure that links rural communities (e.g., gas stations, roads) within the range of kangaroo rats. Access development and resulting increased traffic, light, or noise is expected to alter the suitability of habitat for this species (see 2.4 Access Development and Management). In addition, domestic pets (e.g., dogs and cats) may pose some predation risk to kangaroo rats living nearby.

2.3.1 Beneficial Management Practices for Rural, Urban and Commercial Development

- Follow BMPs specified for industrial development and for access management and development.
- Restrict activities or developments that emit night-time light or noise.
- Night-time traffic speeds should not exceed 50 km/h on roads occupied by kangaroo rats.
- Signage could be installed in key areas to indicate presence of sensitive wildlife species.

2.4 Access Development and Management

The development and maintenance of access routes, such as roads and trails, are associated with nearly all types of development within the range of Ord's kangaroo rat in Alberta. These features are often superficially similar to natural habitats for kangaroo rats, and they may be colonized by the species. The effects of human-created linear features on kangaroo rats are complex and difficult to study. However, recent research has provided considerable insight on both positive and negative impacts of access development. Therefore, a cumulative effects approach should be followed to determine net effects.

Recent research on Ord's kangaroo rat in Alberta has investigated the nature of human-created habitats that exist along roads, trails, fireguards or other linear features (Bender et al. 2005; Robertson 2007; Teucher 2007). Within Alberta, most of these linear features occupied by kangaroo rats are access routes associated with industrial development, particularly oil and gas development, agricultural activities and residential development. Additionally, some of these linear features that were created for other purposes, such as fireguards, are used secondarily for access. This section reviews the implications of access development and related linear features (e.g., fireguards) on kangaroo rats.

Several species of kangaroo rats have been observed to use roads for residences or dispersal among habitats (Roberts and Packard 1973; Kaufman and Kaufman 1982; O'Farrell 1990; Stangl et al. 1992; Price et al. 1994b). It has been suggested that use of roads by endangered Stephens' kangaroo rat (*D. stephensi*) in southern California could potentially increase connectedness between foraging areas or isolated local populations and increase population persistence (Price et al. 1994b; Price and Gilpin 1996; Brock and Kelt 2004). While the same positive impacts may occur for Ord's kangaroo rats in Alberta, a number of negative effects of roads have also been identified. These include both direct and indirect negative effects. Direct effects include mortality associated with vehicle strikes, damage or destruction of residences by road maintenance machinery, and impacts on kangaroo rat activity due to light and noise from vehicle traffic. Indirect effects include: (1) increased risk of predation; (2) increased risk of parasitism by the bot fly, *Cuterebra polita*; (3) effects on diet; (4) effects on soil properties important to establishing burrows (as refuge from low winter temperatures); and (5) fragmentation of habitat by interrupting dispersal between natural habitats such as sand dunes. Each of these effects is reviewed below.

2.4.1 Direct effects

A number of direct effects associated with access development and maintenance have been observed or hypothesized for Ord's kangaroo rat. Night-time vehicle traffic along roads, trails, or other linear features used for access (e.g., fireguards) can result in direct mortality to kangaroo rats. Since 1994, a small number of dead kangaroo rats found along access routes were attributed to vehicle collisions (D. Gummer and D. Bender, pers. comm.). Fortunately, night-time vehicle traffic within the range of the species in

Alberta is low, although increased development could result in significantly higher levels of vehicle traffic and direct mortality.

Access route construction and maintenance can have negative impacts on kangaroo rats and their residences. Kangaroo rats often occupy road margins, and road construction and maintenance equipment may disturb residences by collapsing burrows and/or compacting soils making them uninhabitable.

Vehicles and equipment, or access maintenance, may also negatively affect the above-ground behaviour of kangaroo rats. Kangaroo rats rely on vision, hearing, and the perception of seismic vibrations to detect predators. The noise and seismic vibration generated by vehicles and equipment may interfere with kangaroo rats nearby, and they may forego above-ground activity in response to these activities (thereby missing foraging or mating opportunities, for example). Excessive light generated along access routes may also deter kangaroo rats from being active above ground.

2.4.2 Indirect effects

Historically speaking, roads are a novel feature to kangaroo rats. The species has adapted to its Canadian environment at naturally isolated features (sand dunes) that do not suffer from the direct and indirect effects of roads mentioned above. It is possible that kangaroo rats are unable to recognize that road habitats do not offer the same quality of habitat as natural features, and therefore road habitats may represent an 'ecological trap' (Schlaepfer et al. 2002) to the species. The indirect negative effects of roads and other access routes deserve particular attention because they can have broad and significant impacts on kangaroo rat populations.

Increased risk of predation – Many predators preferentially use roads or other linear access features while travelling and hunting (Bennett 1990; Forman 1995; Zimmerman et al. 1996; James and Stuart-Smith 2000). Therefore, kangaroo rats that occupy road margins may expose themselves to higher risk of predation than kangaroo rats living on isolated natural habitats such as sand dunes. Teucher (2007) used video monitoring and foraging experiments to assess risk of predation for kangaroo rats in Alberta. His results showed that predators were considerably more active along roads than at natural sites (sand dunes), and together with results from his foraging experiments he concluded that kangaroo rats along roads were at significantly higher risk of predation than those inhabiting sand dunes.

Increased risk of parasitism – The bot fly (*Cuterebra polita*) commonly parasitizes Ord's kangaroo rats in Alberta, although it has not been reported as a parasite of kangaroo rat populations elsewhere. While it is not understood why Canadian kangaroo rats are uniquely affected by this parasite, some effects of the bot fly parasite are believed to be detrimental (Gummer et al. 1997; Robertson 2007). Roads have been hypothesized to increase the transmission of the parasite by facilitating the travel of female adult bot flies when laying eggs at potential infection sites (e.g., kangaroo rat burrow entrances; see Robertson 2007). Furthermore, road habitats are highly connected in the landscape,

unlike naturally isolated sand dunes, and this high level of habitat connectivity may facilitate the spread of the parasite. Thus, roads are considered to facilitate the movement and spread of bot flies, and therefore are detrimental to kangaroo rats.

Effects of diet composition – Kangaroo rats in Canada rely on underground caches of forage, primarily seeds, as a food source during the cold winter months when they spend nearly all of their time below ground. Overwinter mortality can be very high (as much as 90%; Gummer 1997a), and presumably winter starvation is a leading cause of death. Gummer et al. (2005) analyzed the diet composition of kangaroo rats in Alberta and found distinct differences in the types of seeds collected in natural versus road habitats. Specifically, a large portion of the seeds collected by kangaroo rats inhabiting roads was from invasive, non-native plant species. Gummer et al. (2005) suggested that these seeds may not represent the same quality of forage as native seeds. Teucher (2007) observed potentially corroborating evidence: kangaroo rats occupying road habitats have poorer body condition than kangaroo rats in more natural habitats. Risk of winter starvation may be higher for kangaroo rats inhabiting roads because of lower quality forage in their food caches. Additional study will be necessary to investigate the effect of invasive plant seeds on forage quality for kangaroo rats.

Effects of soil properties – Kangaroo rats select sites for burrow excavation where there are loose sandy soils to facilitate digging. These types of soils also provide a degree of insulation during the winter months because sandy soils contain large interstitial air spaces between the sand grains that impede the penetration of cold temperatures from the surface. Teucher (2007) examined the properties of soils at natural (sand dune) habitats versus road habitats, and found that soils at kangaroo rat burrows along roads were more compacted. He hypothesized that this would make it more difficult for kangaroo rats to dig through the soil and excavate burrows, and that compact soils would result in cooler burrow temperatures in the winter. Teucher (2007) tested the latter hypothesis, and confirmed colder soil temperatures along roads compared to sand dunes. The implication of this result is that kangaroo rats inhabiting roads likely face greater energetic challenges during the winter than those inhabiting sand dunes.

Effects of habitat fragmentation – Actively-eroding sand dunes, the primary habitat for kangaroo rats, are naturally isolated features. Historically, these patches of habitat would have been linked through the occasional dispersal of kangaroo rats among dunes. However, within the sand hill complexes occupied by kangaroo rats in Alberta, considerable access development has occurred over the last 20 years (Bender et al. 2005). A network of roads, trails and other linear features (e.g., fireguards) now interweaves the landscape between the individual sand dune features. To a dispersing kangaroo rat, these human-created features may be perceived as habitat, although their low quality may not be recognized (i.e., represent an ecological trap; see above). Thus, roads may represent an 'attractive sink' habitat that intercepts dispersing kangaroo rats and prevents them from reaching higher quality natural habitats (e.g., sand dunes). This effect has not been well studied, although recent research has used computer simulation models to demonstrate the effect (Heinrichs et al. 2008; D. Bender, pers. comm.).

2.4.3 Beneficial Management Practices for Access Development and Management

- The construction of new access routes should be avoided in areas occupied by kangaroo rats, particularly sand hill complexes. If unavoidable, vehicle traffic should be minimized on these routes and restricted to periods when the least amount of damage to the ground surface occurs. By doing so, the access feature may be less conspicuous to kangaroo rats, and to their predators and parasites.
- Creation of unnecessary access routes (i.e., redundant pathways to the same location) should be avoided.
- Abandoned access routes should be decommissioned and restored to native habitat.
- To the greatest extent possible, travel along existing access routes should be minimized so that these features become less conspicuous on the landscape (e.g., become more vegetated and appear less like habitat to kangaroo rats). The footprint of existing access routes should not be allowed to increase.
- Access management plans for development/construction activities must include measures to ensure that vehicle or equipment traffic does not contribute to the spread of non-native weedy plant species in areas occupied by kangaroo rats.
- Maintenance of roads and trails should occur in late spring and summer, whenever possible. Avoid expanding or upgrading roads and trails.
- Vehicles and equipment that travel along access routes should be careful to avoid the margins of roads where kangaroo rats are likely to establish burrows. Straddling the tracks or driving at the edge of the road surface should be discouraged.
- Avoid night-time vehicle travel in areas where kangaroo rats occur. Where vehicle travel is necessary, speed limits should be reduced to 50 km/h or less and drivers should be instructed to be vigilant for kangaroo rats on the road. At reduced speeds, it is generally easy to avoid striking a kangaroo rat.

2.5 Military Activities

Approximately, 13% of the Canadian range (COSEWIC 2006) and 36% of the Alberta range (AOKRRT 2005) for kangaroo rats occurs within CFB Suffield. Military training does not occur within the NWA where the majority of the kangaroo rat population within CFB Suffield occurs. Only a very small portion (< 1%) of the natural habitat for this species is within the military training area (D. Bender, pers. comm.). Consequently, military activities are not expected to have a large impact on the Alberta kangaroo rat population. However, kangaroo rats do occur along access routes in areas used for military training, and caution should be exercised in this area (see *2.4 Access Development and Management*).

Military activities have the potential to affect kangaroo rats through alteration of habitat or through direct or indirect effects on survival or behaviour of kangaroo rats. Military vehicles, particularly those that travel off-road, have the potential to alter habitat and/or destroy burrow complexes, or to cause direct mortalities of active rats at night when kangaroo rats are above ground. Visual, auditory and seismic disturbance may affect the behavioural patterns of nearby kangaroo rats, possibly inhibiting above-ground activity.

Disturbance suppression, particularly fire suppression and the removal/exclusion of grazers, may contribute to the stabilization of active sand dunes and loss of habitat.

Operating military vehicles and equipment within areas occupied by kangaroo rats may have a number of effects on the species. Direct mortality can occur at night-time, especially along access routes, if a vehicle strikes a kangaroo rat active above ground (see *2.4 Access Development and Management*). Soil compaction and the collapse of burrows under the weight of a vehicle/equipment can damage or destroy residences. Kangaroo rats are particularly vulnerable to such damage or destruction in the late summer, fall and winter months, because during these periods it may not be possible for animals to re-construct burrows (e.g., if ground is frozen) or replenish/replace winter food caches.

Visual, auditory and seismic disturbances associated with vehicles, equipment, installations, or military activities may affect kangaroo rats. Kangaroo rats are particularly sensitive to ambient light and generally restrict their above-ground activity to periods when natural and ambient light is absent (Kaufman and Kaufman 1982). Night-time illumination from vehicles, equipment or training activities (e.g., night-time artillery illumination) may influence the behavioural patterns of kangaroo rats, and may cause them to avoid above-ground activities (e.g., forego foraging or mate searching).

Loud noise from vehicles (especially armoured vehicles/tracked vehicles), equipment or military training (e.g., explosion of ordnance) may also negatively impact the normal behavioural patterns of wildlife (Larkin 1994) and has the potential to create hearing loss in kangaroo rats. Kangaroo rats depend on keen hearing to detect predators, which may be masked by auditory disturbance originating from the sources above or through hearing loss (Webster 1962; Webster et al. 1968; Webster and Webster 1980; Larkin 1994; McGinn and Faddis 1997) associated with these disturbances. This could result in either higher rates of predation, increased avoidance of above-ground activity during periods of auditory disturbance, or possibly shifts in habitat use.

Seismic disturbance associated with military activities could originate from sources such as the passage of heavy vehicles (particularly armoured vehicles and tracked vehicles), the explosion of ordnance, or range pyrotechnics and demolitions. Kangaroo rats are exceptionally sensitive to seismic vibration (Randall 1994), and it is likely that seismic disturbance can be perceived by kangaroo rats at considerable distances, although very little is known about this form of disturbance.

A less obvious impact of military activities is disturbance suppression, particularly fire suppression and the exclusion of livestock. Military activities in CFB Suffield generate a large number of grass fires each year. While the disturbance from these fires might have beneficial effects for kangaroo rats (e.g., destabilizing vegetated sand dunes), the military is very efficient at suppressing and extinguishing both human-made and natural fires on the Base, and fire suppression activities on the Base undoubtedly reduce the extent of fires. A history of extreme fire suppression has been implicated as a contributing cause of vegetation stabilization in the sand dunes used by Ord's kangaroo rat (COSEWIC 2006). Thus, it is recommended that the Base consider developing policy regarding fire

suppression within the range of Ord's kangaroo rat to directly consider the effects of fire and fire suppression on active sand dune habitat.

Livestock grazing has been excluded from most of the Base where kangaroo rats occur, and this has also been implicated as a potentially contributing factor to dune stabilization and habitat loss for kangaroo rats. However, elk (*Cervus elaphus*) were reintroduced within CFB Suffield in 1997 and 1998 to re-establish a large, native grazer. The effects of elk (and other native ungulate grazers) on sand dunes are under investigation by the Base and researchers from the University of Calgary (D. Bender, pers. comm.).

2.5.1 Beneficial Management Practices for Military Activities

- The use of tracked vehicles or heavy wheeled vehicles should be restricted within and near places where kangaroo rats occur.
- Light sources on equipment or installations should be minimized at night where kangaroo rats occur, especially during the darkest nights of the month when kangaroo rats concentrate their activity.
- The use of artillery illumination, hand-held flares, mortar illumination, etc. should be minimized in areas where kangaroo rats occur. The effects of night-time illumination can be partially mitigated if illumination is avoided during the darkest periods of the month when kangaroo rats are most active, and by keeping the duration of illumination as brief as possible.
- Explosive ordnance and demolitions should be minimized near areas occupied by kangaroo rats.

3.0 RESEARCH RECOMMENDATIONS

Many of the anticipated effects of development on Ord's kangaroo rat are based on a thorough understanding of the species' biology. It is unlikely that future research would demonstrate that these anticipated or hypothesized effects are unimportant. However, there is considerable uncertainty as to the magnitude of these effects and how they impact kangaroo rats. For example, the effect of ambient light on kangaroo rat foraging behaviour is well understood, so night-time artificial lighting is almost certain to negatively affect kangaroo rats nearby. However, what distance constitutes 'nearby' and how far do these effects permeate? Similarly, seismic vibrations (e.g., from drilling or transport of heavy equipment) and auditory disturbances will certainly be perceived by kangaroo rats and potentially disturb them, but within what distance do these effects constitute significant impacts? The following is a list of research recommendations that should be addressed to identify thresholds of potential effects of land uses. Until this recommended work is completed, a precautionary approach should be taken to mitigate effects of these land uses on kangaroo rats.

- The extent to which seismic disturbance (e.g., from drilling, tilling/cultivating, pipeline trenching, travel of vehicles, transportation of equipment, explosion of

ordnance) permeates through the landscape is not well understood. The proximity of effect for each type of seismic disturbance should be determined.

- The extent to which noise disturbance impacts kangaroo rat behavioural patterns requires further investigation. This is particularly true for heavy vehicles (e.g., commercial trucks, road maintenance vehicles, tanks), heavy equipment (e.g., drilling rigs), and installations (e.g., compressor stations).
- The extent to which artificial light disturbs the behavioural patterns of kangaroo rats requires investigation. Research is needed on both short-lived sources of light (e.g., passing of a vehicle at night, artillery illumination) and sustained artificial lighting (e.g., at a drilling site, lights from buildings or other installations). The threshold of illumination effects will be important to investigate; the amount of time it takes for a kangaroo rat to resume its normal activities once the light source has been extinguished will also be a significant topic of research.
- The dispersal capabilities and patterns of dispersal of Ord's kangaroo rats are not well understood in Alberta. Assessing the magnitude of impact from habitat fragmentation by future developments will require additional information about the dispersal behaviour of this species. Specifically, the timing of dispersal, biological characteristics of dispersing animals, causes or cues for dispersal, and limits of dispersal all require investigation.
- There is a need to determine appropriate reclamation practices for sand hill and other sandy habitats. This research should include examining which species of seeds used in reclamation activities would benefit the diversity of wildlife species inhabiting sand hill habitats, including kangaroo rats and other species at risk.

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5.0 APPENDICES

Summarized Beneficial Management Practices for Ord's Kangaroo Rat in Alberta

APPENDIX 1

Beneficial Management Practices for Agricultural Activities within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access management)

Beneficial Management Practices for Agricultural Activities within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access management)

Ord's kangaroo rat (*Dipodomys ordii*) is a medium-sized rodent that, in Canada, is native to Alberta and Saskatchewan. Kangaroo rats spend most of their time in burrows below ground, and emerge on relatively warm nights with little or no moonlight to forage for seeds and search for mates. For these reasons, Ord's kangaroo rat is one of Alberta's most rarely observed wildlife species.

The distribution of Ord's kangaroo rat is very limited in Canada because it requires actively-eroding sand dunes for its primary habitat. Active sand dune habitats are naturally patchy across the prairies and are becoming increasingly rare due to factors that promote stabilization of vegetation by dunes.

In Alberta, Ord's kangaroo rat is found primarily within the Middle Sand Hills region north of Medicine Hat, or in other nearby sand hill habitats. The majority of Alberta's kangaroo rats are found within the eastern portion of CFB Suffield, particularly the Suffield National Wildlife Area, where the species is protected under Canada's *Species at Risk Act*. Throughout Alberta, the species is also protected under Alberta's *Wildlife Act*. Both pieces of legislation list Ord's kangaroo rat as Endangered, meaning it is at imminent risk of extinction provincially and nationally. As such, it is illegal to knowingly harm the species or its burrows.

Identifying features

Ord's kangaroo rat has orange-brown fur on its backside and white fur on its underside, large eyes, and five-toed feet. The species is also characterized by its short front limbs, unusually large hind legs, and an extremely long tail which facilitates its kangaroo-like, hopping style of movement. Ord's kangaroo rat is not related to the Norway rat, an introduced species that is commonly considered vermin.

Key Issues

- Protect naturally eroding sand dune habitats and other sparsely-vegetated sandy areas that provide habitat for the species.
- Prevent habitat loss that occurs from vegetation encroachment and stabilization of actively-eroding sand dunes.
- Beneficial management practices should be applied in all areas where kangaroo rats are known to occur, including both natural sandy habitats and human-created sandy habitats (e.g., roads, trails, fireguards).

Care should be taken in areas known to be occupied by Ord's kangaroo rat. Implementing the following beneficial management practices will help protect Ord's kangaroo rat and its habitat. These recommendations have been developed based on the

biology and habitat requirements of the species and based upon discussion and guidance of species specialists and resource managers.

Domestic Livestock Grazing

Kangaroo rat populations have evolved and persisted under native and domestic grazing regimes. A moderate amount of well-managed grazing is believed to benefit kangaroo rats by preventing vegetation from stabilizing sandy habitats and increasing the amount of bare ground required by kangaroo rats to facilitate their bipedal movement and burrowing. Range management practices that discourage erosion or promote enhanced vegetation cover will typically decrease the suitability of the habitat for kangaroo rats.

Recommended beneficial management practices for domestic livestock grazing

- Moderate amounts of grazing may help maintain habitat for this species.
- Graze annually; removal of livestock may promote stabilization of sandy habitats, which will decrease the suitability of the habitat for kangaroo rats.
- In sand hill habitat, avoid other range management practices that discourage erosion or promote enhanced vegetation cover.

Cultivation

Although naturally eroding, sandy habitats used by kangaroo rats appear to require some level of disturbance to prevent stabilization by vegetation, cultivation is **not** a compatible form of disturbance. Kangaroo rats are generally not found in cultivated fields, although they may occupy fallow fields or the sandy margins of cultivated fields. These human-created habitats are frequently disturbed and kangaroo rats typically do not survive long in these habitats.

Recommended beneficial management practices for cultivated areas

- Avoid cultivating sandy soils, particularly sand dunes, sand flats and steep slopes in sand hill areas.
- Avoid use of heavy machinery in sandy habitats or in areas where burrows are observed, such as the margins of roads, trails and fireguards.
- Avoid direct application of pesticides, herbicides or other chemicals to areas inhabited by kangaroo rats.

Roads, Trails and Fireguards

As naturally sandy habitats have become rare, kangaroo rats have colonized sandy, human-created features/habitats such as unpaved roads, trails and fireguards. Despite the species occurrence in these human-created habitats, these areas may represent lower quality habitat for the species and kangaroo rats occupying these areas may experience higher mortality, predation and parasitism. There are several fireguards in Alberta that appear to have relatively stable numbers of kangaroo rats from year to year. This

stability appears to be associated with extremely low vehicle traffic, infrequent maintenance, and low connectivity with other linear features (i.e., these fireguards generally do not connect to multiple roads or other fireguards).

Recommended beneficial management practices for roads, trails and fireguards

- Vehicles that travel along access routes should be careful to avoid the margins of roads or trails where kangaroo rats are likely to establish burrows. Avoid straddling the tracks or driving at the edge of the road surface.
- Avoid night-time vehicle travel in areas where kangaroo rats occur. Where vehicle travel is required, reduce speed to 50 km/h or less and be vigilant for kangaroo rats on the road. At reduced speeds, it is generally easy to spot a kangaroo rat and avoid striking it.
- Minimize vehicle traffic on fireguards, and maintain them late in the spring rather than early in the spring when kangaroo rats are more sensitive to disturbance.

Additional Literature

Kissner, K.J. 2009. Beneficial management practices for Ord's kangaroo rat in Alberta. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Report No. 125. Edmonton, AB. 42 pp.

APPENDIX 2

Beneficial Management Practices for Industrial Development within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access development, maintenance and use)

Beneficial Management Practices for Industrial Development within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access development, maintenance and use)

Ord's kangaroo rat (*Dipodomys ordii*) is a medium-sized rodent that, in Canada, is native to Alberta and Saskatchewan. Kangaroo rats spend most of their time in burrows below ground, and emerge on relatively warm nights with little or no moonlight to forage for seeds and search for mates. For these reasons, Ord's kangaroo rat is one of Alberta's most rarely observed wildlife species.

The distribution of Ord's kangaroo rat is very limited in Canada because it requires actively-eroding sand dunes for its primary habitat. Active sand dune habitats are naturally patchy across the prairies and are becoming increasingly rare due to factors that promote stabilization of dunes by vegetation.

In Alberta, Ord's kangaroo rat is found primarily within the Middle Sand Hills region north of Medicine Hat, or in other nearby sand hill habitats. The majority of Alberta's kangaroo rats are found within the eastern portion of CFB Suffield, particularly the Suffield National Wildlife Area, where the species is protected under Canada's *Species at Risk Act*. Throughout Alberta, the species is also protected under Alberta's *Wildlife Act*. Both pieces of legislation list Ord's kangaroo rat as Endangered, meaning it is at imminent risk of extinction provincially and nationally. As such, it is illegal to knowingly harm the species or its burrows.

Identifying features

Ord's kangaroo rat has orange-brown fur on its backside and white fur on its underside, large eyes, and five-toed feet. The species is also characterized by its short front limbs, unusually large hind legs, and an extremely long tail which facilitates its kangaroo-like, hopping style of movement. Ord's kangaroo rat is not related to the Norway rat, an introduced species that is commonly considered vermin.

Key Issues

- Protect naturally eroding sand dune habitats and other sparsely-vegetated sandy areas that provide habitat for the species.
- Beneficial management practices should be applied in all areas where kangaroo rats are known to occur, including both natural sandy habitats and human-created sandy habitats (e.g., roads, trails, fireguards).

Care should be taken in areas known to be occupied by Ord's kangaroo rat. Implementing the following beneficial management practices will help protect Ord's kangaroo rat and its habitat. These recommendations have been developed based on the biology and habitat requirements of the species and based upon discussion and guidance of species specialists and resource managers.

Industrial Development

Industrial activities have the potential to affect kangaroo rats through (1) habitat alteration, (2) effects on their behaviour, or (3) indirect effects on survival.

(1) Habitat alteration

Installations and infrastructure (e.g., access routes) associated with industrial development reduce habitat for this species. Other practices, such as the use of straw crimping, drift fences, and landscape fabrics may impede movements of kangaroo rats between habitats. These practices may also change the natural vegetation cover, thereby increasing stabilization of the habitat and decreasing its suitability to kangaroo rats. Thus, the use of these tools should be minimized as much as possible in habitats used by kangaroo rats.

The timing of new developments greatly affects kangaroo rats and their habitats. Generally, activities that are conducted during winter when the ground is frozen likely minimizes disturbance to kangaroo rat habitat. However, kangaroo rats themselves are most vulnerable at this time, so it is essential that predevelopment surveys accurately identify that kangaroo rats are not present in an area at the time that development occurs. The optimal timing for surveys will vary from year to year depending on weather conditions, and therefore the precise dates are difficult to specify. For winter development activities, typically it would be appropriate to conduct predevelopment surveys between mid-September and the onset of partial snow cover (typically early November) on dry, warm (nightly low temperature >5˚C), dark nights (e.g., a new moon period) that provide adequate survey conditions (see Alberta Sustainable Resource Development 2005; Bender et al. 2007). If it is not possible to delay development activities until winter, surveys should also be conducted immediately prior to development and under appropriate survey conditions (dry, warm, dark nights). If there is potential for night-time traffic or construction activities, development should occur during bright nights (e.g., week of the full moon) when kangaroo rats are typically less active.

(2) Effects on kangaroo rat behaviour

Development activities that generate bright lights, loud noise, or seismic vibration may influence kangaroo rat behaviour. Kangaroo rats are highly sensitive to ambient light conditions and restrict their behaviour when any form of light (daylight, moonlight, artificial light) is present. Light from industrial developments and installations (e.g., gas refineries and compressor stations) or construction activities at night that require bright lights, are expected to negatively influence kangaroo rat behaviour and should be minimized.

Kangaroo rats have highly specialized ears and rely on their hearing to detect predators. Night-time construction or the operation of facilities that produce intermittent or

continuous noise (e.g., compressor stations) may negatively influence behaviour patterns, damage the hearing of kangaroo rats, or make them more susceptible to predators.

Kangaroo rats are very good at sensing seismic vibrations, and they can use vibrations to detect predators. The noise and seismic vibration generated by vehicles and equipment may interfere with kangaroo rats nearby, changing their activity patterns or making them more susceptible to predation. Excessive seismic vibration may also collapse burrows, especially in natural habitats where burrows are typically constructed in very loose, sandy soils.

(3) Direct or indirect effects on survival

Industrial activity is often associated with the development and maintenance of access routes, such as roads and trails. These features are sometimes occupied by kangaroo rats, although they do not represent ideal habitat. Access routes are prone to disturbance from traffic and road maintenance, and may result in increased vehicle mortalities or the damage of burrows. Recent research has also shown that kangaroo rats living along roads suffer higher rates of predation and parasitism.

Disturbance and vegetation removal associated with many industrial developments can also increase the potential for invasive, non-native species to colonize and spread through native habitats. Kangaroo rats appear to require native plants seeds for food to sustain themselves through the winter. Non-native, weedy plants species pose a significant threat to kangaroo rats if these plants exclude the native plants that are required for forage. Thus, practices to reduce the invasion of non-native species should be implemented when working in habitats used by kangaroo rats. Reclamation of sites dominated by non-native plants may be beneficial, especially if the reclamation seed mixtures are augmented with the seeds of common food items used by kangaroo rats, such as the seeds of scurf pea (*Psoralea lanceolata*), annual sunflower (*Helianthus couplandii*), narrow-leaved puccoon (*Lithospermum incisum*), northern wheat grass (*Agropyron dasystachyum*), prickly pear (*Opuntia* sp.), western bluebur (*Lappula occidentalis*), and sand dropseed (*Sporobolus cryptandrus*) (see Gummer et al. 2005).

Recommended beneficial management practices

- Development activities are best conducted in winter to reduce their footprint on the prairie, provided that kangaroo rats have been confirmed to be absent from the development site during fall prior to the onset of partial snow cover.
- Conduct predevelopment surveys using established survey protocols for this species (Alberta Sustainable Resource Development 2005; Bender et al. 2007).
- Land users should respect recommended minimum setback distances to protect individuals and their burrow complexes (Scobie and Faminow 2000; Alberta Sustainable Resource Development 2001; Saskatchewan Environment 2003; Alberta Sustainable Resource Development, in review).
- Whenever possible, use existing infrastructure (e.g., roads) or minimize infrastructure (e.g., multi-pad wellsites).

- Minimize all activities that generate noise, seismic vibration, or artificial light at night within the range of Ord's kangaroo rat.
- Minimize vehicle traffic at development sites, especially at night. Where vehicle traffic must occur, all kangaroo rat burrows should be conspicuously marked and avoided to prevent destruction or damage of burrows.
- Ensure that any traffic stays on existing access routes and does not venture off of established roads/trails, particularly if there are residences of kangaroo rats nearby.
- To the greatest extent possible, minimize travel along existing access routes so that these features do not become conspicuous on the landscape. The footprint of existing access routes should not be allowed to increase.
- Vehicles and equipment that travel along roads should avoid the margins of roads or trails where kangaroo rats are likely to establish burrows. Avoid straddling the tracks or driving at the edge of the road surface.
- Drivers should reduce speed to 50 km/h or less and be vigilant for kangaroo rats on the road. At reduced speeds, it is generally easy to spot a kangaroo rat and avoid it.
- Creation of unnecessary access routes (i.e., redundant pathways to the same location) should be avoided.
- Abandoned access routes should be decommissioned and restored to native habitat.
- Access management plans must include measures to ensure that vehicle or equipment traffic does not contribute to the spread of non-native weedy plant species in areas occupied by kangaroo rats.
- Maintenance of roads and trails should occur in late spring and summer, whenever possible. Avoid expanding or upgrading roads and trails.
- Implement practices that reduce the spread of invasive species, such as use of certified weed-free seed mixes during reclamation.
- Avoid use of herbicide to reduce invasion by weedy, non-native species at development sites, particularly within and nearby kangaroo rat habitats.
- Re-seed using native species only, and include species that are beneficial to the diet of kangaroo rats (see Gummer et al. 2005).
- Minimize use of erosion control measures and over-seeding during reclamation.

Additional Literature

Alberta Sustainable Resource Development. 2001. Recommended land use guidelines for protection of selected wildlife species and habitat within the Grassland and Parkland natural regions of Alberta. Available online: http://www.srd.gov.ab.ca/fishwildlife/guidelinesresearch/pdf/landuse/GrasslandParkland.pdf.

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APPENDIX 3

Beneficial Management Practices for Rural, Urban and Commercial Development within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access development, maintenance and use)

Beneficial Management Practices for Rural, Urban and Commercial Development within the Range of Ord's Kangaroo Rat in Alberta (including recommendations on access development, maintenance and use)

Ord's kangaroo rat (*Dipodomys ordii*) is a medium-sized rodent that, in Canada, is native to Alberta and Saskatchewan. Kangaroo rats spend most of their time in burrows below ground, and emerge on relatively warm nights with little or no moonlight to forage for seeds and search for mates. For these reasons, Ord's kangaroo rat is one of Alberta's most rarely observed wildlife species.

The distribution of Ord's kangaroo rat is very limited in Canada because it requires actively-eroding sand dunes for its primary habitat. Active sand dune habitats are naturally patchy across the prairies and are becoming increasingly rare due to factors that promote stabilization of dunes by vegetation.

In Alberta, Ord's kangaroo rat is found primarily within the Middle Sand Hills region north of Medicine Hat, or in other nearby sand hills habitats. The majority of Alberta's kangaroo rats are found within the eastern portion of CFB Suffield, particularly the Suffield National Wildlife Area, where the species is protected under Canada's *Species at Risk Act*. Throughout Alberta, the species is also protected under Alberta's *Wildlife Act*. Both pieces of legislation list Ord's kangaroo rat as Endangered, meaning it is at imminent risk of extinction provincially and nationally. As such, it is illegal to knowingly harm the species or its burrows.

Identifying features

Ord's kangaroo rat has orange-brown fur on its backside and white fur on its underside, large eyes, and five-toed feet. The species is also characterized by its short front limbs, unusually large hind legs, and an extremely long tail which facilitates its kangaroo-like, hopping style of movement. Ord's kangaroo rat is not related to the Norway rat, an introduced species that is commonly considered vermin.

Key Issues

- Protect naturally eroding sand dune habitats and other sparsely-vegetated sandy areas that provide habitat for the species.
- Beneficial management practices should be applied in all areas where kangaroo rats are known to occur, including both natural sandy habitats and human-created sandy habitats (e.g., roads, trails, fireguards).

Care should be taken in areas known to be occupied by Ord's kangaroo rat. Implementing the following beneficial management practices will help protect Ord's kangaroo rat and its habitat. These recommendations have been developed based on the biology and habitat requirements of the species and based upon discussion and guidance of species specialists and resource managers.

Rural, Urban and Commercial Development

Habitat used by kangaroo rats in Alberta tends to be isolated (sand dunes) or inaccessible (e.g., CFB Suffield lands). As such, these habitats are not generally conducive to large-scale urban or commercial developments. Small-scale developments of rural residences or associated infrastructure that links rural communities (e.g., gas stations, roads) could result in habitat loss or fragmentation and increased traffic, light, or noise that could alter the suitability of habitat for this species. In addition, domestic pets (e.g., dogs and cats) may pose some predation risk to kangaroo rats living nearby.

Recommended beneficial management practices

- Minimize all developments or activities that generate artificial light, noise or seismic vibration within the range of Ord's kangaroo rat.
- Development activities are best conducted in winter to reduce their footprint on the prairie, provided that kangaroo rats have been confirmed absent from the development site.
- Conduct predevelopment surveys using established survey protocols for this species (Alberta Sustainable Resource Development 2005; Bender et al. 2007).
- Whenever possible, use existing infrastructure (e.g., roads) or minimize infrastructure.
- Land users should respect recommended minimum setback distances to protect individuals and their burrow complexes (Scobie and Faminow 2000; Alberta Sustainable Resource Development 2001; Saskatchewan Environment 2003; Alberta Sustainable Resource Development, in review).
- Minimize vehicle traffic at development site, especially at night. Where vehicle traffic must occur, all kangaroo rat burrows should be conspicuously marked and avoided to prevent destruction or damage of burrows.
- Ensure that any traffic stays on existing access routes and does not venture off of established roads/trails, particularly if there are kangaroo rat burrows nearby.
- Use erosion protection measures (e.g., straw crimping or drift fences) judiciously within or nearby kangaroo rat habitats.
- Implement practices that reduce the spread of invasive species, such as cleaning equipment and vehicles prior to accessing work sites and use of certified weed-free seed mixes.
- Avoid use of herbicide at development sites to reduce invasion by weedy, non-native species, particularly within and nearby kangaroo rat habitats.
- Signage should be installed in key areas to indicate presence of sensitive wildlife species.

Access Development and Management

The development and maintenance of access routes, such as roads and trails, are often associated with development and construction activities. These linear features are sometimes occupied by kangaroo rats, but are generally prone to disturbance from traffic and road maintenance, and may result in increased mortality or destruction of burrows.

Recent research has shown that kangaroo rats living along roads and trails may suffer higher rates of predation and parasitism. Roads and trails often associated with high abundances of non-native, weedy species and their seeds may provide a poor diet for kangaroo rats. Roads and trails may also intercept dispersing kangaroo rats that might otherwise have dispersed to higher quality, naturally sandy habitats.

Recommended beneficial management practices

- Avoid construction of new access routes in areas occupied by kangaroo rats, particularly sand hill complexes. If unavoidable, vehicle traffic should be minimized and restricted to periods when the least amount of damage to the ground surface occurs, typically the winter months when the ground is frozen. By doing so, the access feature may be less conspicuous to kangaroo rats, and their predators and parasites.
- Creation of unnecessary access routes (i.e., redundant pathways to the same location) should be avoided.
- Abandoned access routes should be decommissioned and restored to native habitat.
- Access management plans during construction/development must include measures to ensure that vehicle or equipment traffic does not contribute to the spread of non-native weedy plant species in areas occupied by kangaroo rats.
- Maintenance of roads and trails should occur in late spring and summer, whenever possible. Avoid expanding and upgrading roads and trails.
- Vehicles should be careful to avoid the margins of roads or trails where kangaroo rats are likely to establish burrows. Avoid straddling the tracks or driving at the edge of the road surface.
- Limit night-time vehicle travel in areas where kangaroo rats occur. Where vehicle travel is required, reduce speed to 50 km/h or less and be vigilant for kangaroo rats on the road. At reduced speeds, it is generally easy to spot a kangaroo rat and avoid striking it.

Additional Literature

Alberta Sustainable Resource Development. 2001. Recommended land use guidelines for protection of selected wildlife species and habitat within the Grassland and Parkland natural regions of Alberta. Available online: http://www.srd.gov.ab.ca/fishwildlife/guidelinesresearch/pdf/landuse/GrasslandParkland.pdf.

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Thank you!